After making history, NASA’s tiny deep-space satellites go silent

The first two tiny satellites to ever go interplanetary have fallen silent in deep space for some unknown reason, and it’s likely we may never hear from them again. But for NASA, which launched the probes last year, this loss of communication isn’t considered a failure. Before the pair went quiet, these vehicles demonstrated that tiny satellites could become critical tools for exploring other worlds deep within our Solar System.

The silent satellites are the two MarCO probes — nicknamed EVE and WALL-E from Pixar’s sci-fi movie — which flew to Mars along with NASA’s InSight lander last year. Both MarCOs are modified CubeSats, a type of standardized small satellite about the size of a cereal box used for space research. Before the InSight mission, CubeSats had only ever orbited around Earth, but NASA wanted to know if these types of satellites could be useful on deep-space missions, too.

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The MarCO satellites demonstrated just that and more, exceeding everyone’s expectations. They launched along with the InSight lander on May 5th, and flew in formation with the spacecraft all the way to the Red Planet. Once InSight got to Mars and started its descent to the surface on November 26th, the MarCO satellites observed the landing sequence from overhead and sent real-time status updates back to Earth. That way, NASA knew how each step of the landing process went just minutes after it happened. “We got the data much earlier than we would have — in near real-time as the landing was happening — adding to the excitement of the event,” Joel Krajewski, the project manager of the MarCO spacecraft at NASA’s Jet

Propulsion Laboratory, tells *The Verge*.

These quick notifications were a luxury that NASA wouldn't have had without the MarCO satellites. Other, larger spacecraft in orbit around Mars were gathering data of InSight's landing, too. But because of their locations and the positions of the planets, it took a while for these vehicles to send that info back to Earth. For instance, NASA's Mars Reconnaissance Orbiter, which has been in orbit around the Red Planet since 2006, observed the InSight landing from the Martian skies but then quickly dipped below the horizon. It wasn't able to send back the data until three hours after the landing.



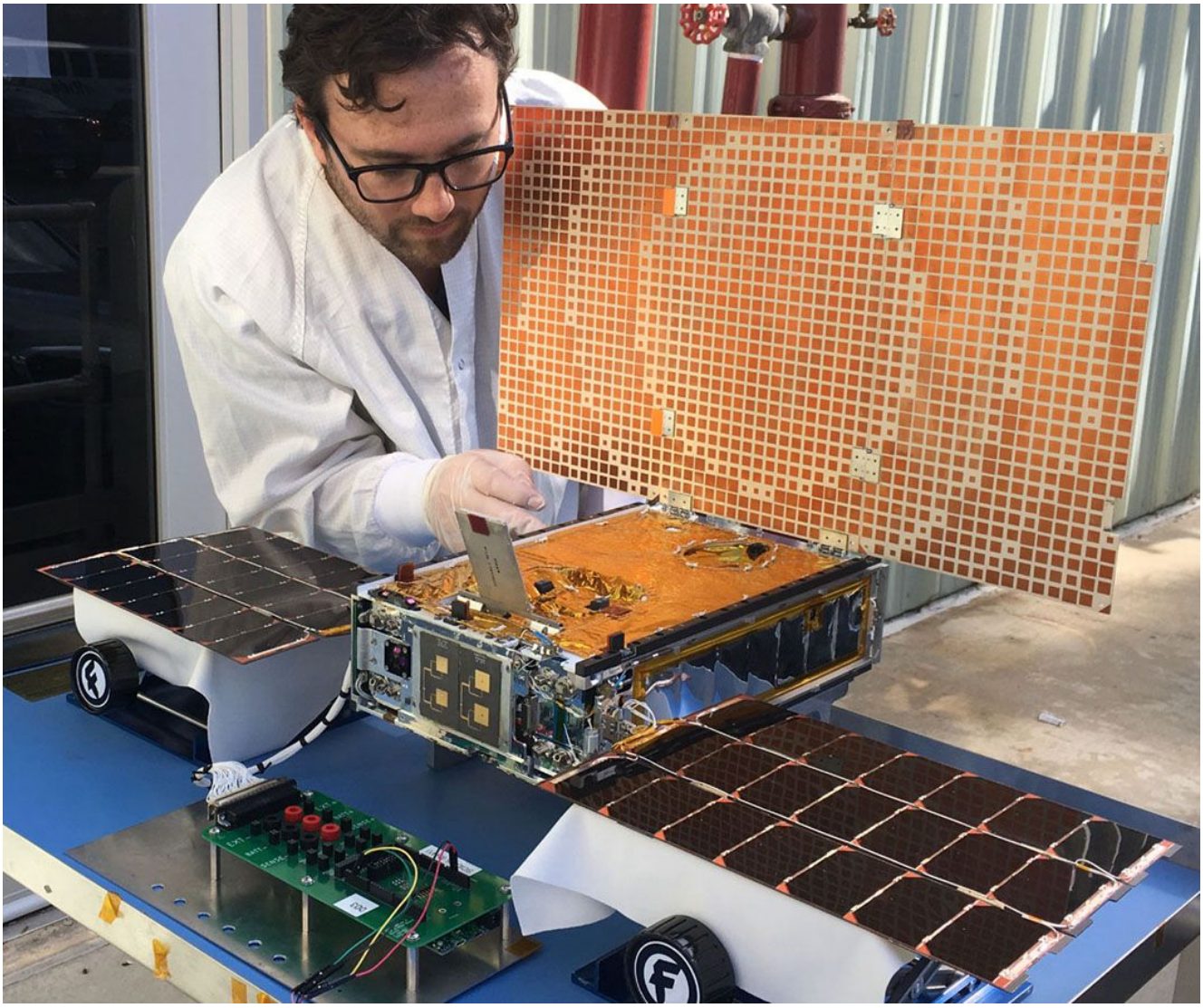

What MarCO-B, or WALL-E, saw as it approached Mars
Image: NASA

If something had gone wrong during InSight's landing, it might have taken some time for NASA to diagnose and work the problem without the MarCO satellites. "We always want to get data from a landing while it's happening, in case the unfortunate happens and we lose a lander," Krajewski says. "We want the equivalent of the airline black box to understand as much as possible." Fortunately, InSight's landing was flawless, and so were the MarCO satellites'. The satellites even sent back the first picture that InSight's camera took on Mars, showing a flat red surface through a dirty camera lens.

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But while the MarCOs were a resounding success, they weren't really designed to last beyond the InSight landing. "This mission was experimental from day one, where much of the objective of MarCO was simply to survive as we traveled out to Mars," Andy Klesh, the MarCO chief engineer at NASA JPL, tells *The Verge*, adding that, "two months into the mission, we had

proven every piece of our technology.” After observing the InSight landing, the satellites ended up in orbit around the Sun, and for about a month, they sent signals back to Earth. But in late December and early January, NASA lost communication with WALL-E and EVE within just one week of each other. The space agency hasn’t been able to regain contact since, leading engineers to think the twins might be gone for good.

The MarCO team isn’t exactly sure why the satellites have gone silent. It’s possible that deep-space cosmic rays hit the probes’ electronics, knocking both of the spacecraft out. But engineers also knew that WALL-E had a leaky thruster. Both MarCOs were equipped with thrusters that expel cold gas to maneuver through space (just like the fictional WALL-E). The satellites need this hardware to point their radio antennas back towards Earth – and the farther away these satellites get from Earth, the more precisely they need to point to be heard. A leak may mean that WALL-E has run out of fuel, and the satellite can’t precisely point anymore.



One of the twin MarCO satellites before launch
Image: NASA

Another theory is that both of them are just getting too far from the Sun, and that's making it harder for them to get power. Each MarCO satellite has sensors designed to detect the location of the Sun, so they can both properly orient their solar panels. But as the satellites get farther away from the Sun, these sensors may be having a hard time figuring out where the star is. As a result, the MarCOs aren't pointing properly and aren't getting enough light on their panels.

If it's the latter problem, then there may be some hope to recover the satellites. Right now, their orbit is taking them farther and farther away from the Sun, but they'll be coming back around again in the months ahead. In August, they'll be at the same distance from the Sun as they were during the

flyby. It’s possible the sensors will be able to locate the Sun again and the MarCOs can power back up. “We might talk to them again,” says Krajewski. “We’ll schedule a few more attempts to find them.”

“We’re deep into extra credit territory here.”
Even if the MarCOs stay silent forever, the mission team is still incredibly pleased with what they’ve accomplished. The MarCOs were made with a budget of just $18.5 million, a bargain compared to InSight’s budget of nearly $830 million. And the satellites did fulfill what they had been set out to do. “We’re deep into extra credit territory here,” Krajewski says.

The team has also shown that CubeSat technologies can fare well in a deep-space environment. Each MarCO was equipped with a specialized radio about the size of a fist that can communicate up to millions of miles away. The satellites also had systems for adjusting the spacecraft’s orientation, solar panels, and thrusters. These technologies were made specifically to fit each CubeSat, and they had never operated together on such a small vehicle bound for deep space before. Future CubeSat missions are already adopting this new technology. One such mission, known as Lunar Flashlight, will send a CubeSat to the space near the Moon to look for ice inside lunar craters. And it’s going to need some of the same basic tech that the MarCOs just demonstrated.

Additionally, CubeSats could accompany future larger missions to deep space, serving as communication relays to Earth. This would be especially helpful in places like Venus, for instance, which doesn’t have a vast network of communication satellites like Mars does. Or it’s possible that engineers might want to send tiny spacecraft to explore inhospitable areas of space, like the turbulent tail of a comet or the plumes of water bursting forth from Saturn’s moon Enceladus. That way if they get destroyed, it’s not as much of a financial loss.

Ultimately, MarCO proved that such ideas aren’t so far-fetched. “Small spacecraft not only allow us to do relay communications, but further our scientific interests as well,” says Klesh.

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